

LVII.—*A Revision of the "Genus" Peneus, with Diagnoses of some new Species and Varieties.* By A. ALCOCK, M.B., LL.D., F.R.S.

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I. INTRODUCTION.

The "genus" *Peneus* (type *P. monodon*) was established in the year 1798 by Fabricius for three species from the "Indian Ocean," one of which (*P. planicornis*), since its antennular flagella are described as compressed, should, perhaps, be translated to the genus *Solenocera* of Lucas (Ann. Soc. Entom. France, 2 sér. vol. viii. 1850, p. 219).

Milne-Edwards (Hist. Nat. Crust. ii. 1837, pp. 411-418) deals critically with eleven species which he assigns to *Peneus*; but two of them have since been transferred to *Solenocera*, a genus with which we are not now concerned.

In 1881 in these 'Annals' (vol. viii. ser. 5, p. 169) Spence Bate published, along with a preliminary notice of the 'Challenger' Peneidæ, an account of the results of an examination of Milne-Edwards's types. In this paper the "genus" *Peneus* is left intact, except that certain forms with long antennular flagella are referred to as *Peneopsis*, a MS. name of A. Milne-Edwards. *Peneopsis* was not properly characterized, nor has its type (*P. serrata*) ever, as far as I can ascertain, been described; but if the two species—one of which bore A. Milne-Edwards's MS. label "*Peneopsis ocularis*"—described under this name by Faxon (Mem. Mus. Comp. Zool. Harvard, xviii. 1895, p. 187) may be taken as typical of the genus, then *Peneopsis* differs from all *Penei* and agrees with all Peneinæ except *Peneus* in having two arthrobranchiæ on the penultimate pair of legs. So that *Peneopsis*, like *Solenocera*, may be left out of consideration in a review of the phratry or maniple *Peneus*.

In 1885 S. I. Smith (Proc. U.S. Nat. Mus. viii. p. 170) proposed to restrict the name *Peneus* to those species in which (1) the endopodite of the maxillules is elongate and segmented, (2) the third maxillipeds have an epipodite, and (3) the last thoracic somite carries a pleurobranch. To the

species *not* thus characterized he applied the name *Parapeneus*. In this paper the author objected to the action of Miers and Kingsley in lumping his genus *Xiphopeneus* (1869) with *Peneus*, and emphasized the distinctive characters of *Xiphopeneus*.

In 1891 Wood-Mason, in these 'Annals' (ser. 6, vol. viii. p. 271), pointed out that certain *Parapenei* differed from the type species (*Parapeneus membranaceus*, Risso, = *P. longirostris*, Lucas) in not possessing the characteristic sutures of the carapace and in having a filamentous vestige of an anterior arthrobranch on the penultimate thoracic appendage. To these forms he gave the name *Metapeneus*.

Wood-Mason also recognized that *Peneus styliferus*, Edw., though it possesses the carapacial sutures which are a marked feature of *Parapeneus membranaceus*, Risso, is unlike that species in having curved lamellar exopodites on all the thoracic legs. He therefore separated *P. styliferus* and gave it the MS. name *Parapeneopsis*, probably because *P. styliferus* happens to have the long antennular flagella which Spence Bate had chosen as the distinctive mark of *Peneopsis*. Unfortunately for the aptness of the name *Parapeneopsis*, several of the species which must be transferred to this section or genus have short antennular flagella.

In 1896 de Man ('Zoologischer Anzeiger,' p. 111) published a description of a new Peneid, which, from the peculiar size and length of the first pair of chelipeds of the male, he made the type of a distinct genus, *Heteropeneus*. The observations of Nobili (Boll. Mus. Torino, 1903, no. 455) seem to show that the difference between *Heteropeneus* and *Peneus* is, perhaps, rather less than the difference between the latter genus and *Parapeneus*, *Metapeneus*, &c.; so that *Heteropeneus* should be taken into the mantle *Peneus*.

In 1901, in 'A Catalogue of Indian Deep-sea Crustacea,' p. 15, I suggested that *P. curvirostris*, Stimpson (= *P. anchoralis*, Spence Bate), should be detached from the genus *Parapeneus*, where it had been placed by other authors, and should be made the type of a new subgenus or genus *Trachypeneus*.

In the present paper all the sections—genera or subgenera—into which the old Fabrician genus has gradually become split are tabulated and briefly defined, and an attempt is made to sift all the species that have been described under the name *Peneus* and to distribute them in their proper sections. It is but an attempt, because to allocate the species with confidence requires exact information regarding the grooves and sutures of the carapace, the presence or

absence of exopodites, the disposition of epipodites and branchiæ, the form of the endopodite of the maxillule, and the armature of the telson; and these particulars are often not to be found in descriptions.

Fortunately, however, I have not been entirely dependent on descriptions and figures, for when I was in England in 1897 I was allowed, through the kindness of Professor Jeffrey Bell, to examine at my leisure the collection of *Penei* in the British Museum, which includes the 'Challenger' material determined by Spence Bate, the various species described and identified by Miers, and Henderson's Madras specimens described in the 'Transactions of the Linnean Society' for 1893: all these I went through and tabulated, specimen by specimen, with an eye to a revision of the genus. Moreover, in the Indian Museum I have had at my disposal (1) a collection made about thirty years ago in the Andamans by that discriminating carcinologist James Wood-Mason; (2) miscellaneous donations and purchases from India, China, and Japan; and, chief of all, (3) the many hundreds of specimens trawled and dredged by the 'Investigator' off all the coasts and islands of British India, from the Indus Delta to Mergui, during twenty-four years. A very considerable part of the Indian Museum material had been sorted and named by Wood-Mason before his death in 1893, and I must add that I have incorporated Wood-Mason's rough memoranda and used his MS. names (except where they have been anticipated) in this paper.

I must also add that the contents of this paper refer exclusively to the maniple *Peneus*.

*Solenocera*, *Parasolenocera*, *Peneopsis*, *Philonicus*, *Haliporus*, and *Artemisia* are excluded, as they all have two arthrobranchiæ on the penultimate thoracic leg, and the first five have the cervical groove deeply impressed on the tergum of the carapace.

*Funchalia* is excluded for the present, as it has long, sickle-shaped, cross-cutting mandibles.

## II. DEFINITION OF THE MANIPLE *PENEUS*.

### *PENEUS*, Fabr.

*Peneus* Fabricius, Entomol. Syst. Suppl. 1793, p. 408; Latreille, Hist. Nat. Crust. vi. 1803, p. 246; Leach, Trans. Linn. Soc. xi. 1815, pp. 336, 347, and Malacost. Podophth. Brit., text of pl. xlii.; Desmarest, Consid. Gén. Crust. 1825, p. 224; Milne-Edwards, Hist. Nat. Crust. ii. 1837, p. 411; De Haan, Faun. Japon., Crust. 1849, p. 188; Dana, U.S. Expl. Exp., Crust. pt. i. 1852, p. 601; Bell, Brit. Stalk-

eyed Crust. 1853, p. 317; Heller, Crust. südl. Europ. 1863, p. 292; Miers, P. Z. S. 1878, p. 298; Boas, Stud. ov. Decapod., Vid. Selsk. Skr. 6 Række, nat. o. math. Afd. i. 2, 1880, p. 165; Spence Bate, Ann. & Mag. Nat. Hist. (5) viii. 1881, p. 173, and 'Challenger' Macrura, 1888, p. 229; Haswell, Cat. Austral. Crust. 1882, p. 198; S. I. Smith, Proc. U.S. Nat. Mus. viii. 1885, p. 170; Ortman, in Bronn's Thierreich, Malacostraca, pp. 1118-1120; Holmes, Occas. Papers Calif. Acad. Sci. vii. 1900, p. 217; Kishinonye, Journ. Fisheries Bureau, Tokyo, viii. no. 1 (1900); Alcock, Cat. Indian Deep-sea Crust. 1901, p. 13.

Rostrum well developed, laterally compressed. Carapace with postantennular (antennal) and hepatic spines, sometimes with a small postocular (orbital) tooth or spine, and sometimes with a spine (branchiostegal) at or near its antero-inferior angles. *The cervical groove is never impressed on the tergum of the carapace.* Abdomen long, with some of its posterior somites compressed and their terga carinated.

Eyes large. Basal joint of antennular peduncle hollowed dorsally to lodge the eye; its outer edge terminates in a spine, and from the proximal end of its inner edge there springs a twisted setose scale (antennular scale); the antennular flagella are cylindrical and tapering and may be short or long, but are never as long as the body. Antennal scale large and foliaceous, its outer edge is rigid and terminates acutely; antennal flagellum very long. The mandible has a jagged cutting-edge and a broad grinding crown; its palp (endopodite) is large and broadly foliaceous, consisting of two segments, of which the anterior is very much the larger. The endopodite of the maxillule (first maxilla) may be long and 2-, 3-, or 4-jointed, or may be without segmentation and truncated; that of the maxilla (second) is short.

The endopodite of the first maxillipeds is slender and 5-jointed, that of the second and of the third consists of 7 segments. The exopodite of the second and third maxillipeds is very well developed, being curved, compressed, stiffish, and made up, like the flagella of the antennæ, of numerous small joints. The third maxillipeds are long and pediform. The first three pairs of legs are chelate, the first pair usually being the shortest and the third pair usually the longest. The last two pairs of legs are monodactylous. Exopodites are usually present on all or all but the last pair of thoracic legs, but are sometimes altogether wanting.

No podobranchiæ exist on any of the true legs, and *only one arthrobranch*—the posterior one—is present on the penultimate legs.

The abdominal appendages are of moderate length, the

exopodite being longer than the endopodite. In the first pair there are no endopodites, but in the male their place is taken by a pair of more or less rigid, longitudinally pleated, or convoluted plates, known as the "petasma" or "andricum," which together form a tube or canal. In the second pair the endopodite carries at its base in the male a fleshy papilla.

According to Zittel, the first remains of *Peneus*, so far as is known at present, appear in the Lithographic Slates of Bavaria (Jurassic).

The forms included in the maniple *Peneus* are found in greatest abundance off the coasts of the Indo-Pacific, from the Red Sea and east coast of Africa (as far as 33° S.) eastwards to Japan and Australia. Eastwards of this centre a few species occur in the western meridians of the Pacific, up to the shores of California and Panama; and westwards of it three species are found in the Mediterranean, two of which extend into the N. Atlantic (one of them ranging as far north as St. George's Channel), and about ten occur off the Atlantic coasts of America, from New England, through the Gulf of Mexico and Caribbean, doubtfully as far south as the northern end of Patagonia.

Taking the distribution of the several genera of the phratry or maniple (or subgenera of the genus) in order:—

*Peneus* (s. r.) has the widest range, being found all round the globe, from the Gulf of Mexico, through the Atlantic coasts of N. Africa, the Mediterranean, the Red Sea, and the Indo-Pacific, to California and Panama.

*Heteropeneus* has been found only in the East Indian Archipelago (Singapore and Japan).

*Parapeneus* occurs in the West Indies and off the Atlantic coast of the U.S. America, in the Mediterranean and its western approaches, and in Oriental seas from India to Fiji.

*Metapeneus*: this large genus is almost entirely Indo-Pacific (Red Sea to Polynesia), two doubtful species being found in the West Indies.

*Parapeneopsis* is confined to the Indo-Pacific, ranging from India to China and Japan.

*Xiphopeneus* is confined to the Atlantic coasts of sub-tropical and tropical America.

*Trachypeneus* is found, on the one hand, in the West Indies and neighbouring coasts of America, and, on the other hand, in Oriental seas from India to Japan.

*Atypopeneus* is known with certainty only from the Bay of Bengal, but it probably occurs also in the China Sea.

*Key to the Genera of the Maniple Peneus.*

- I. Rostrum serrated both on its dorsal and on its ventral edge; a pleurobranch on the last thoracic somite (XIV.); exopodites on all or all but the last pair of the thoracic legs.
1. First pair of chelipeds short. . . . . *Peneus* (s. r.).
  2. The first pair of chelipeds of the male are, typically, stouter and vastly longer than the second and third pairs . . . . . *Heteropeneus*.
- II. Rostrum serrated on its dorsal edge only.
1. A pleurobranch on somite XIII. but not on somite XIV.
    - i. Exopodites on all or all but the last pair of the thoracic legs . . . . . *Metapeneus*.
    - ii. The thoracic legs have no exopodites . . . . . *Parapeneus* (s. r.).
  2. No pleurobranchiæ on somites XIII. and XIV.; all the thoracic legs with exopodites.
    - i. Epipodites wanting from at least the last three pairs of thoracic legs. . . . . *Parapeneopsis*.
    - ii. Epipodites absent from only the last two pairs of legs.
      - a. Last two pairs of legs of normal form.
        - A. Antennular flagella short. . . . . *Trachypeneus*.
        - B. Antennular flagella much longer than the carapace . . . . . *Atypopeneus*.
      - b. Last two pairs of legs extremely long and slender (flagelliform) . . . . . *Xiphopeneus*.

III. DIAGNOSES OF THE CONSTITUENT GENERA AND TABLES OF THE SPECIES OF THE SEVERAL GENERA.

1. *PENEUS*, Fabr. (sensu restricto).

*Peneus*, Fabr., Sidney I. Smith, Proc. U.S. Nat. Mus. viii. 1885, p. 170.

Type, *P. caramote*, Risso.

Rostrum toothed both dorsally and ventrally. Antero-inferior angles of carapace not spiniform. Postantennular sulcus of carapace defined by a dorsal as well as a ventral ridge.

Antennular flagella short or of moderate length. Endopodite of maxillules (first maxillæ) elongate and distinctly 3-jointed. Exopodites present on all or all but the last pair of the thoracic legs.

Epipodites present on all but the last two thoracic appendages; pleurobranchiæ present on the six posterior thoracic somites.

Andricum symmetrical, simple, pod-shaped; it consists of two lobes finely interlocking all along their anterior border, and capable of loose apposition in more or less of their posterior border, the opposed faces being concave.

The dactylus of the third maxillipeds often shows modifications of a secondary sexual nature in the adult male.

The branchial formula is as follows:—

Somite.	Podo-branchiæ.	Arthro-branchiæ.	Pleuro-branchiæ.	Total.
VII. ....	ep.	1 (small)	.. =	ep.+1
VIII. ....	ep.+1	2	.. =	ep.+3
IX. ....	ep.	2	1 =	ep.+3
X. ....	ep.	2	1 =	ep.+3
XI. ....	ep.	2	1 =	ep.+3
XII. ....	ep.	2	1 =	ep.+3
XIII. ....	..	1	1 =	2
XIV. ....	..	..	1 =	1
Total ....	6 ep.+1	12	6 =	6 ep.+19

In addition to the Indian forms hereafter specified, I have examined the following species:—*P. caramote*, *P. japonicus*, *P. australiensis*, *P. latisulcatus*, *P. brasiliensis*, *P. setifer*, *P. stylirostris*.

*List of the Species of PENEUS (sensu restricto).*

- Antennular flagella extremely short; usually a postocular (as well as a postantennular) spine and crest on the anterior part of the carapace.*
- Peneus caramote* (Risso), Milne-Edwards, Hist. Nat. Crust. ii. p. 413 et syn. (= *P. trisulcatus*, Leach, Tr. Linn. Soc. xi. 1815, p. 347.)—Mediterranean, W. Africa, England (St. George's Channel).
- Peneus canaliculatus* (Oliv.), Milne-Edwards, *op. cit.* p. 414. (= *P. marginatus*, Randall, Journ. Ac. Nat. Sci. Philad. 1839, p. 146, and ? *P. plebejus*, Hess, Arch. f. Naturges. xxxi. i. 1865, p. 168, pl. vii. fig. 19.)—Indo-Pacific from Red Sea and E. coast of Africa to Sandwich Is.; also W. coast of Africa.
- Peneus canaliculatus*, var. *australiensis*, Spence Bate, 'Challenger' Macrura, p. 248, pl. xxxii. fig. 3.
- Peneus canaliculatus*, var. *japonicus*, Spence Bate, *op. cit.* p. 245, pl. xxxi., pl. xxxii. fig. 4, pl. xxxvii. fig. 2.
- Peneus brevirostris*, Kingsley, Proc. Ac. Nat. Sci. Philad. (1878) 1879, p. 93. (According to Miers doubtfully distinct from *P. canaliculatus*.)—W. coast of Nicaragua.
- Peneus californiensis*, Holmes, Occasional Papers Calif. Acad. Sci. vii. 1900, p. 218. (A doubtful species, originally identified by Holmes with *P. canaliculatus*.)—California.

7. *Peneus latusulcatus*, Kishinouye, Journ. Fisheries Bureau, Tokyo, viii. i. 1900, p. 12, pl. ii. fig. 2. (Perhaps a form of *P. canaliculatus*.)—Japan.
8. *Peneus brasiliensis*, Latreille, Milne-Edwards, *op. cit.* p. 414.—Both sides of Atlantic in warm latitudes.

II. *Antennular flagella not so long as their peduncle; no postocular spine and crest.*

9. *Peneus monodon*, Fabr., Milne-Edwards, Hist. Nat. Crust. ii. p. 416. (= *P. esculentus*, Haswell, P. L. S. N.S.W. iv. 1879, p. 38; also = *P. ashikaka*, Kishinouye, Journ. Fish. Bur. Tokyo, viii. i. 1900, p. 14, pl. iii.)—Indo-Pacific from E. Africa at least to Japan and Australia.
10. *Peneus carinatus*, Dana, U.S. Expl. Exp., Crust. pt. i. p. 602, pl. xl. fig. 2. (Probably = *P. monodon*, Fabr.)—Singapore.
11. *Peneus setiferus* (L.), Milne-Edwards, *op. cit.* p. 414. (= *P. fluviatilis*, Say, Journ. Acad. Nat. Sci. Philad. 1817, p. 235.)—Atlantic coasts of America in warm latitudes.  
(*P. orbignyanus*, Latr., is supposed by Milne-Edwards (*op. cit.* p. 415) to be identical with this species.)

III. *Antennular flagella longer than their peduncle; no postocular spine and crest.*

12. *Peneus indicus*, Milne-Edwards, Hist. Nat. Crust. ii. p. 415.—E. Africa to the Malay Archipelago and perhaps beyond.  
*Peneus indicus*, var. *merguensis*, de Man, Journ. Linn. Soc., Zool. xxii. 1888, p. 287, pl. xviii. fig. 8, pl. xix. fig. 1; and Zool. Jahrb., Abth. Syst. x. 1888, p. 680.—All coasts of India, also Java.  
*Peneus indicus*, var. *penicillatus*, Wood-Mason, MS.—Coasts of India.
13. *Peneus occidentalis*, Streets, Proc. Acad. Nat. Sci. Philad. 1871, p. 243. (Supposed by Miers to = *indicus*, Edw.)—Panama.
14. *Peneus stylirostris*, Stimpson, Ann. Lyc. Nat. Hist. N. York, x. 1874, p. 134. (Supposed by Miers to = *indicus*, Edw.)—Panama.
15. *Peneus balboæ*, Faxon, 1893, *vide* Mem. Mus. Comp. Zool. Harvard, xviii. 1895, p. 181, pl. xlvii. figs. 1-1 c.—Off Cocos Island (Panama), 770 fath.

IV. *No exopodite on the last pair of thoracic appendages.*

16. *Peneus semisulcatus*, De Haan, Faun. Japon., Crust. 1850, p. 191, pl. xlvi. fig. 1.—E. Africa to Australia and Japan.  
*Peneus tahitensis*, Heller, 'Novara' Crust. 1865, pl. xi. fig. 2. (Seems to be identical with *P. semisulcatus*, De H.)—Tahiti.  
*Peneus gracilirostris*, Thallwitz, Abh. u. Ber. Zool. Mus. Dresden (1890-91), 1892, no. 3, p. 3, fig. 5. (Probably identical with *P. semisulcatus*, De H.)—N. Celebes.
17. *Peneus cæruleus*, Stebbing, Marine Investig. S. Africa, Crust. pt. iii. 1905, p. 77, pls. xxi., xxi. bis.—E. coast of S. Africa, about 33° S.

2. HETEROPENEUS, de Man.

*Heteropeneus*, de Man, Zool. Anzeiger, 1896, p. 111, and Zool. Jahrb., Syst. Abth. x. 1898, p. 684, pl. xxxviii. fig. 75; Nobili, Boll. Mus. Torino, xviii. 1903, no. 455, p. 4.

Rostrum toothed both dorsally and ventrally. Antero-inferior angles of carapace not spiniform. Postantennular



sulcus defined ventrally only, by the buttress of the post-antennular (antennal) spine.

Antennular flagella short. The first pair of thoracic legs may, in the adult male, be enormously elongate, especially as to the propodite; but in the female, and, as Nobili has shown, in certain adult males, may be of the ordinary *Peneus* form. Exopodites are present on all the thoracic legs.

According to Nobili, epipodites are present on all but the last two thoracic appendages, and pleurobranchiæ on the six posterior thoracic somites.

Andricum symmetrical, simple, much as in *Peneus* (s. r.).

According to Nobili, the branchial formula is the same as that of *Peneus* (s. r.).

Only the following species is known:—

*Heteropeneus longimanus*, de Man, *loc. cit.*; see also Nobili, *loc. cit.*—Java Sea; Singapore.

### 3. METAPENEUS, Wood-Mason.

*Metapeneus*, Wood-Mason, *Ann. & Mag. Nat. Hist.* (6) viii. 1891, p. 271.

Type, *M. affinis*, Edw.

Rostrum toothed on its dorsal edge only. Antero-inferior angles of carapace either rounded or spiniform. Post-antennular sulcus defined only ventrally by the buttress of the postantennular (antennal) spine. No longitudinal or transverse sutures on the carapace.

Antennular flagella short or of moderate length. Endopodite of maxillules (first maxillæ) somewhat abbreviated, two-jointed. Exopodites present on all or all but the last pair of thoracic legs.

Epipodites absent from the third maxillipeds as well as from the last two thoracic appendages. No pleurobranch on the last thoracic somite.

Andricum complicated, symmetrical or asymmetrical: if symmetrical its distal angles are more or less spout-like; if asymmetrical one lobe is either larger or longer than the other, and both are split up into interleafed convoluted lobules.

The third maxillipeds never exhibit secondary sexual characters in the male, but the last pair of thoracic legs sometimes do.

The branchial formula is:—

Somite.	Podo- branchiæ.	Arthro- branchiæ.	Pleuro- branchiæ.	Total.
VII. ....	ep.	<i>r</i>	..	= ep. + <i>r</i>
VIII. ....	ep. + 1	2	..	= ep. + 3
IX. ....	..	2	1	= 3
X. ....	ep.	2	1	= ep. + 3
XI. ....	ep.	2	1	= ep. + 3
XII. ....	ep.	2	1	= ep. + 3
XIII. ....	..	1	1	= 2
XIV. ....	..	..	..	= 0
Total ....	5 ep. + 1	11 + <i>r</i>	5	= 5 ep. + 17 + <i>r</i>

In addition, a small filamentous vestige of an anterior arthrobranch is present on the penultimate thoracic somite in all the species I have examined, which include, besides the Canadian species, *M. Joyneri*, *M. tenellus*, *M. Macleayi*, *M. philippinensis*, *M. Richtersi*, and *M. Batei*.

*List of the Species of METAPENEUS, Wood-Mason.*

1. *No marginal subterminal articulating spines on the telson. Last pair of thoracic legs without exopodite; their merus, in the adult male, with a notch and spine or tooth at its proximal end.*
1. *Metapeneus monoceros*, Fabricius, Milne-Edwards, Hist. Nat. Crust. ii. p. 415.—E. Africa to Japan and Australia.  
(*Metapeneus incisipes*, Spence Bate, 'Challenger' Macrura, p. 257, pl. xxiv. fig. 2, seems to be identical with *M. monoceros*.)
2. *Metapeneus affinis*, Milne-Edwards, *op. cit.* p. 416.—Karachi to Japan.  
(*Metapeneus plunicornis*, Fabricius, according to Milne-Edwards, closely resembles *M. affinis*, but may possibly, since it has the antennular flagella compressed, not be a *Peneus* at all.)  
(*Metapeneus mutatus*, Lanchester, P. Z. S. 1901, ii. p. 572, pl. xxxiv. fig. 6, seems to be identical with *M. affinis*.)
3. *Metapeneus Joyneri*, Miers, Ann. & Mag. Nat. Hist. (5) v. 1880, p. 458, pl. xv. figs. 8-10.—Japan.
4. *Metapeneus Dobsoni*, Miers, P. Z. S. 1878, p. 302, pl. xvii. fig. 2.—India and Ceylon.
5. *Metapeneus brevicornis*, Milne-Edwards, *op. cit.* p. 417. (= *M. avirostris*, Dana, U.S. Expl. Exp., Crust. pt. i. p. 603, pl. xl. fig. 3.)—Mauritius to Borneo.  
(*Metapeneus* sp., Lanchester, P. Z. S. 1901, ii. p. 571, pl. xxxiv. fig. 7, does not seem to differ essentially from *M. brevicornis*, Edw.)
6. *Metapeneus lysianassa*, de Man, Journ. Linn. Soc., Zool. xxii. 1888, p. 290, pl. xix. fig. 1.—Orissa to Singapore.

*The following species appear to belong to this group, having no movable spines on the margin of the telson, though the condition of the last pair of thoracic legs as regards exopodite &c. is not on record:—*

7. *Metapeneus tenellus*, Spence Bate, 'Challenger' Macrura, p. 270.—Japan.
8. *Metapeneus crucifer*, Ortmann, Zool. Jahrb., Syst. Abth. v. 1890, p. 451, pl. xxxvi. figs. 5 a, b.—Japan.

9. *Metapeneus Mastersii*, Haswell, P. L. S. N.S.W. 1879, p. 42, and Cat. Austral. Crust. p. 203. (Considered by de Man to be doubtfully synonymous with *M. monoceros*, Fabr.)—Australia.
- I. a. *Telson without marginal spines; merus of last pair of thoracic legs of male without notch at base.*
- Metapeneus Deschampsii*, Nobili, Boll. Mus. Zool. Torino, xviii. 1903, no. 452, p. 2, fig. 1.—Pondichery and Mahé. This may possibly be the non-adult form of *M. monoceros*, Fabr.
- ? *Metapeneus villosus*, Guérin, in Voy. 'Coquille,' vol. ii. Zool., Crust. p. 36, and Icon. Règne Animal, pl. xx. fig. 1.—Australia. May perhaps belong here.
- II. *Apex of telson with 3 or 4 pairs of lateral marginal spines.*
10. *Metapeneus ensis*, De Haan, Faun. Japon., Crust. p. 192, pl. xlv fig. 2.—Japan.  
(*Metapeneus intermedius*, Kishinouye, Journ. Fish. Bureau, Tokyo, viii. 1900, p. 21, is possibly the same as *M. ensis* (*M. monoceros ensis*) of De Haan.)  
This species, if my identification be correct, has no exopodite to the last pair of thoracic legs.
11. *Metapeneus Macleayi*, Haswell, P. L. S. N. S. Wales, iv. 1879, p. 40, and Cat. Austral. Crust. p. 201. (No exopodite to last pair of thoracic legs; related to *M. ensis*.)—Australia.
12. *Metapeneus Stebbingi*, Nobili, Bull. Mus. d'Hist. Nat. Paris, 1904, p. 229. (Male with a notch and spine on merus of last pair of legs; probably related to *M. ensis*.)—Red Sea, Suez.
13. *Metapeneus cognatus*, Nobili, l. c. (Belongs to *M. ensis* group.)—Djibouti.
14. *Metapeneus philippinensis*, Spence Bate, 'Challenger' Macrura, p. 261, pl. xxxv. figs. 2, 3. (All the thoracic legs with exopodites.)—East Indian Archipelago, 82–150 fathoms.
15. *Metapeneus coniger*, Wood-Mason, Ann. & Mag. Nat. Hist. (6) viii. 1891, p. 272. (All the thoracic legs with exopodites.)—Off coasts of India, 68–250 fathoms.
16. *Metapeneus andamanensis*, Wood-Mason, t. c. p. 271. Variety of *M. coniger*.—Andaman Sea, 100–244 fathoms; and off C. Comorin, 143 fathoms.
17. *Metapeneus gracilis*, Dana, U.S. Expl. Exp., Crust. pt. i. p. 606, pl. xl. figs. 7 a, b. (Probably belongs to *M. philippinensis* group.)—Sulu Sea; Australia.
18. *Metapeneus Richtersii*, Miers, Zool. II.M.S. 'Alert,' p. 564, pl. lii. fig. A. (Has exopodites on all the thoracic legs, and probably belongs to the *M. philippinensis* group.)—Madagascar Seas.
19. *Metapeneus commensalis*, Borradaile, P. Z. S. 1898, p. 1001. (Probably belongs to the *M. philippinensis* group.)—Rotuma, S. Pacific.
20. *Metapeneus stridulans*, Wood-Mason, MS. (All the thoracic legs have exopodites and the antennular flagella are extremely short.) This species may be the same as *M. akayebi*, Rathbun, which, as Miss Rathbun points out, is one of the several species confused by Spence Bate with *M. velutinus*, Dana.—Indian Seas, 20–35 fathoms.
21. *Metapeneus akayebi*, Rathbun, Proc. U.S. Nat. Mus. xxvi. 1902, p. 39. (All the thoracic legs with exopodites; antennular flagella very short.)—Japan.

Some of the 'Challenger' specimens identified by Spence Bate with *velutinus* probably belong here, according to Miss Rathbun.

22. *Metapeneus mogiensis*, Rathbun, *l. c.* (As *stridulans* and *akayebi* as regards exopodites.)—Japan. Two of Spence Bate's specimens of "*M. velutinus*" presented to the Indian Museum are this species.
23. *Metapeneus Dalei*, Rathbun, *t. c.* p. 40. (*M. akayebi* group.)—Japan.
24. *Metapeneus acclivis*, Rathbun, *t. c.* p. 41. (*M. akayebi* group.)—Japan.
25. *Metapeneus consobrinus*, Nobili, Bull. Mus. d'Hist. Nat. Paris, 1904, p. 229. (*M. akayebi* group.)—Djibouti.
26. *Metapeneus Vaillanti*, Nobili, *l. c.* (*M. akayebi* group.)—Red Sea; Suez.
27. *Metapeneus perlarum*, Vaillant, Bull. Mus. d'Hist. Nat. Paris, 1905, p. 158. (*M. akayebi* group.)—Persian Gulf.
28. *Metapeneus lamellatus*, De Haan, Faun. Japon., Crust. p. 193, pl. xlvi. figs. 4, 5. (Probably *M. akayebi* group.)—Japan.
29. *Metapeneus Batei*, Miers, Zool. II.M.S. 'Alert,' p. 296, pl. xxii. fig. D. (Probably *M. akayebi* group.)—Australia.

The following species may possibly come into the *M. akayebi* alliance:—

30. ? *Metapeneus velutinus*, Dana, U.S. Expl. Exp., Crust. pt. i. p. 604, pl. xl. fig. 4.—Sandwich Islands.
31. ? *Metapeneus palmensis*, Haswell, P. L. S. N. S. Wales, 1879, p. 43, and Cat. Austral. Crust. p. 204.—Australian Seas.
32. ? *Metapeneus pubescens*, Stimpson, Ann. Lyc. Nat. Hist. New York, x. 1874, p. 133.—St. Thomas, W. Indies.
33. ? *Metapeneus Goodei*, S. I. Smith, Proc. U.S. Nat. Mus. viii. 1885, p. 176.—Bermuda; Bay of Panama.

#### 4. PARAPENEUS, S. I. Smith (sensu restricto).

*Parapeneus*, S. I. Smith, Proc. U.S. Nat. Mus. viii. 1885, p. 170.

Type, *P. membranaceus*, Risso (= *P. longirostris*, Lucas).

Rostrum toothed dorsally only. Antero-inferior angles of carapace usually with, sometimes without, a branchiostegal spine. Postantennular sulcus defined only ventrally, by the postantennular (antennal) spine.

A longitudinal suture is generally present on either side, extending from the orbital to the posterior border of the carapace, and also a vertical suture extending across the branchiostegite at the level of the second pair of chelipeds.

Antennular flagella of moderate length. Endopodite of maxillules (first maxillæ) abbreviated, unsegmented, the small terminal segment which is present in *Metapeneus* not being differentiated. No exopodites on any of the thoracic legs.

Epipodites absent from the third maxillipeds, as well as from the last two thoracic appendages. No pleurobranch on the last thoracic somite.

Andricum symmetrical.

The third maxillipeds and last pair of thoracic legs are not known to show any modifications in the male.

The branchial formula is the same as that of *Metapeneus*, but the rudimentary arthrobranch of somite VII. (second maxillipeds) seems to be absent, and there is no vestigial filament, representing an anterior arthrobranch, on the penultimate thoracic somite.

In addition to the Indian species I have examined specimens of *P. membranaceus* and *P. serratus*.

*List of the Species of PARAPENEUS, S. I. Smith (sensu restricto).*

- I. *Telson with a single pair of lateral marginal spines, which are fixed; carapace with a fine longitudinal fissure, extending on either side from the orbital to the posterior border; tip of adult andrium cut up into spines or hooks and lobules or filaments.*
1. *Parapeneus membranaceus* (Risso), Heller, Crust. siidl. Europa, p. 296, pl. x. fig. 11. (= *P. longirostris*, Lucas, Hist. Nat. Anim. Artic. in Expl. Sci. Algérie, Zool. i. pt. 1, p. 46, pl. iv. fig. 6, = *P. Bocagei*, Johnson, P. Z. S. 1863, p. 255, and 1867, p. 900.)—Mediterranean and its western approaches.
  2. *Parapeneus politus*, S. I. Smith, Proc. U.S. Nat. Mus. iii. 1881, p. 144. —N. Atlantic coast of U.S. America.
  3. *Parapeneus megalops*, S. I. Smith, Proc. U.S. Nat. Mus. viii. 1885, p. 172.—W. Indies and neighbourhood, 155–288 fathoms.
  4. *Parapeneus fissurus* (Spence Bate), 'Challenger' Macrura, p. 263, pl. xxxvi. fig. 1.—Bay of Bengal to S. Pacific, up to 115 fathoms.
  5. *Parapeneus investigatoris*, Alcock & Anderson, Ann. & Mag. Nat. Hist. (7) iii. 1899, p. 279.—Gulf of Manár, Bay of Bengal, Andaman Sea, up to 419 fathoms.
  6. *Parapeneus americanus*, Rathbun, Bull. U.S. Fish. Comm. for 1900 (1901) p. 102. ("May prove to be a subspecies of *P. investigatoris*.")—Porto Rico, 220–225 fathoms.
  7. *Parapeneus longipes*, Alcock, *infra*.—Coasts of India and Ceylon,  $7\frac{1}{2}$ –68 fathoms. Distinguished by the absence of a branchiostegal spine.
- II. *Telson with 2 or 3 pairs of articulating marginal spinelets, in addition to the fixed pair; carapace without longitudinal sutures; adult petasma simple, open-pod-shaped.*
8. *Parapeneus rectacutus* (Spence Bate), 'Challenger' Macrura, p. 266, pl. xxxvi. fig. 2.—Fiji, Philippines, Andamans, Bay of Bengal, 95–418 fathoms.
  9. *Parapeneus serratus* (Spence Bate), *op. cit.* p. 268, pl. xxxvii. fig. 1.—Fiji, 315 fathoms; Torres Strait, 1400 fathoms.

5. PARAPENEOPSIS, Wood-Mason, MS.

*Parapeneopsis*, Alcock, Cat. Indian Deep-sea Crust. 1901, p. 14.

Type, *P. stylifera*, Edw.

Rostrum toothed dorsally only. Antero-inferior angles of carapace sharp or dentiform. Postantennular sulcus defined

only ventrally, by the buttress of the postantennular (antennal) spine.

Carapace with longitudinal and transverse sutures as in most *Parapenei*, but the longitudinal suture never reaches the posterior border.

Antennular flagella either long or short. Endopodite of maxillules (first maxillæ) short, unsegmented. Petaloid exopodites are present on all the thoracic legs.

Epipodites absent from the third maxillipeds as well as from the last three thoracic appendages, sometimes absent from *all* the legs. No pleurobranchiæ on the last two thoracic somites.

Andrium symmetrical. The third maxillipeds and fifth pair of legs are not known to be modified in the male.

The branchial formula is:—

Somite.	Podo-branchiæ.	Arthro-branchiæ.	Pleuro-branchiæ.	Total.
VII. ....	ep.	.. (or r)	.. =	ep.
VIII. ....	ep. +1	2	.. =	ep. +3
IX. ....	..	2	1 =	3
X. ....	ep. or 0	2	1 =	(ep.) +3
XI. ....	ep. or 0	2	1 =	(ep.) +3
XII. ....	..	2	1 =	3
XIII. ....	..	1	.. =	1
XIV. ....	..	..	.. =	0
Total. .	4 (or 2) ep. +1	11 (+r?)	4 =	$\frac{4}{2}$ ep. + 16 (+r?)

The vestigial arthrobranch of somite VII. is often absent.

#### List of the Species of *PARAPENEOPSIS*, Wood-Mason.

- I. *Epipodites* present on the second maxillipeds and first two pairs of legs.  
*Telson with lateral marginal spinelets.*
1. *Parapeneopsis stylifera* (Edw.), Milne-Edwards, Hist. Nat. Crust. ii. p. 418.—Coasts of India.  
*Parapeneopsis stylifera*, var. *coromandelica*, nov.—East coast of India.
- II. *Epipodites* present on the second maxillipeds and first two pairs of legs.  
*Telson with small lateral marginal spinelets only as an occasional anomaly.*
2. *Parapeneopsis sculptilis* (Heller), 'Novara' Crust. p. 122, pl. xi. fig. 1.  
—Seas of India and East Indian Archipelago.  
*Parapeneopsis sculptilis*, var. *Mardwickii*, Miers, P. Z. S. 1878, p. 300, pl. xvii. fig. 1.—Coasts of India.  
*Parapeneopsis sculptilis*, var. *cultrirostris*, nov.—Coromandel coast.
3. *Parapeneopsis cornuta* (Kishinouye), Journ. Fish. Bur., Tokyo, viii. 1900, no. 1, p. 23.—Japan; India?

(*Parapeneopsis macillipedo*, Alcock.—Bombay, Madras, Arakan coast. This species may prove to be identical with *P. cornuta*, Kish.)

4. *Parapeneopsis uncta*, Alcock, sp. n.—Ganjam coast.
5. *Parapeneopsis nana*, Alcock, sp. n.—Coromandel coast.
6. *Parapeneopsis gracillima*, Nobili, Boll. Mus. Torino, xviii. no. 447, 1903, p. 4, fig. 1.—Borneo.

III. *Epipodite present on the second maxillipeds only.*

7. *Parapeneopsis acclivirostris*, Alcock, sp. n.—Persian Gulf, Coromandel coast.
8. *Parapeneopsis Hungerfordii*, Alcock, sp. n.—Hongkong.

## 6. TRACHYPENEUS, Alcock.

*Trachypeneus*, Alcock, Cat. Indian Deep-sea Crust. 1901, p. 15.

Type, *T. curvirostris*, Stimpson (= *T. anchoralis*, Spence Bate).

Rostrum toothed dorsally only. Antero-inferior angles of carapace fairly well pronounced. Postantennular sulcus defined only ventrally.

Carapace with longitudinal and transverse sutures, but the former is very short, existing only in the orbital region.

Antennular flagella short. Endopodite of maxillules short, unsegmented. Petaloid exopodites are present on all the thoracic legs.

Epipodites absent from third maxillipeds, as well as from the last two thoracic appendages. No pleurobranchiæ on the last two thoracic somites.

Andricum symmetrical. The third maxillipeds and last thoracic legs are not known to be modified in the male.

The branchial formula is:—

Somite.	Podo-branchiæ.	Arthro-branchiæ.	Pleuro-branchiæ.	Total.
VII. ....	ep.	..	..	= ep.
VIII. ....	ep.+1	2	..	= ep.+3
IX. ....	..	2	1	= 3
X. ....	ep.	2	1	= ep.+3
XI. ....	ep.	2	1	= ep.+3
XII. ....	ep.	2	1	= ep.+3
XIII. ....	..	1	..	= 1
XIV. ....	..	..	..	= 0
Total ....	5 ep.+1	11	4	= 5 ep.+16

In addition to the Indian species I have examined specimens of *T. curvirostris* (= *T. anchoralis*) and *T. constrictus*.

List of the Species of *TRACHYPENEUS*, Alcock.

1. *Trachypeneus barbatus* (De Haan), Faun. Japon., Crust. p. 192, pl. xlvi. fig. 3.—Japan.  
 (*Trachypeneus curvirostris* (Stimpson), Proc. Acad. Nat. Sci. Philad. 1860, p. 44.—Japan. Probably identical with *T. barbatus* = *P. affinis barbatus*, De Haan.)  
 (*Trachypeneus granulosus* (Haswell), P. L. S. N. S. Wales, 1879, p. 41, and Cat. Austral. Crust. p. 202.—N.E. Australia. Probably, as other authors also have thought, identical with *T. curvirostris* = *T. barbatus*.)  
 (*Trachypeneus anchoralis* (Spence Bate), 'Challenger' Macrura, p. 258, pl. xxxv. fig. 1.—Arafura Sea; Japan. Probably, as other authors have thought, a synonym of *T. granulosus* = *T. curvirostris* &c.)
2. *Trachypeneus asper*, Alcock, sp. n.—Persian Gulf; Coromandel coast; Andamans.
3. *Trachypeneus constrictus* (Stimpson), Ann. Lyc. Nat. Hist. N. York, x. 1874, p. 135.—Atlantic coast of U.S. America; West Indies.  
*Trachypeneus constrictus*, var. *similis* (S. I. Smith), Proc. U.S. Nat. Mus. viii. 1885, p. 175.—Atlantic coast of U.S. America; West Indies.

7. *XIPHOPENEUS*, S. I. Smith.

*Xiphopeneus*, S. I. Smith, Amer. Journ. Sci. xlviii. 1869, p. 390; see also Proc. U.S. Nat. Mus. viii. 1885, p. 1888.

Type, *X. Kroyeri*, Heller.

Rostrum toothed dorsally only. Antero-inferior angles of carapace subdentiform. Postantennular sulcus defined only ventrally.

Carapace with longitudinal and transverse sutures, but the former is not prolonged to the posterior border.

One of the antennular flagella is very long. Endopodite of maxillule short, unsegmented. All the thoracic legs have exopodites.

Epipodites are absent from the third maxillipeds and last two pairs of thoracic legs. No pleurobranchiæ on the last two thoracic somites.

*The last two pairs of thoracic legs are of great length, their three terminal joints forming a long slender flagellum.*

The branchial formula is:—

Somite.	Podo-branchiæ.	Arthro-branchiæ.	Pleuro-branchiæ.	Total.
VII. ....	ep.	<i>r</i>	.. =	ep. + <i>r</i>
VIII. ....	ep. + 1	2	.. =	ep. + 3
IX. ....	..	2	1 =	3
X. ....	ep.	2	1 =	ep. + 3
XI. ....	ep.	2	1 =	ep. + 3
XII. ....	ep.	2	1 =	ep. + 3
XIII. ....	..	1	.. =	1
XIV. ....	..	..	.. =	0
Total ....	5 ep. + 1	11 + <i>r</i>	4 =	5 ep. + 16 + <i>r</i>



I have examined the specimens in the British Museum.  
This genus contains the single species :—

*Xiphopeneus Kroyeri* (Heller), SB. k. Akad. Wiss. Wien, 1862, xlv. B, Abth. i. p. 425, pl. ii. fig. 51. (= *X. Harttii*, Smith, Amer. Journ. Sci. xlviii. 1869, p. 390, and Trans. Connect. Acad. ii. 1871, p. 28, pl. i. fig. 1.)—Brazil; W. Indies.

#### 8. ATYPOPENEUS, gen. nov.

Rostrum toothed dorsally only. Antero-inferior angles of carapace rectangular. Postantennular sulcus not defined at all. No longitudinal or transverse carapacial sutures.

*Antennular flagella much longer than the carapace.* Endopodite of maxillules slender. Filamentous exopodites on all the thoracic legs.

Epipodites absent from third maxillipeds and last two pairs of thoracic legs. No pleurobranchiæ on the last two thoracic somites.

The andrium is symmetrical.

Type, *Peneus compressipes*, Henderson, Trans. Linn. Soc., Zool. (2) v. 1893, p. 450, pl. xl. figs. 21, 22.

As Henderson surmised, this is a unique form and is worthy of a separate position.

This genus or section includes, at present, only Henderson's *Peneus compressipes*; but two of Stimpson's species from Hongkong, viz. *P. podophthalmus* and *P. stenodactylus*, may possibly be assigned to it.

#### 9. SEDIS INCERTÆ.

1. *Peneus villosus*, Guérin, in Voy. 'Coquille,' vol. ii. Zool., Crust. p. 36; and Icon. Règne Anim. pl. xx. fig. 1.—Australia. Probably a *Metapeneus*, as the figure shows ventral edge of rostrum smooth, foliaceous exopodites, and no carapacial sutures.
2. *Peneus foliaceus*, Risso, Hist. Nat. Eur. mérid. v. 1826, p. 69, pl. ii. fig. 6.—Mediterranean. Probably a *Parapeneus*, as the figure shows no exopodites to the thoracic legs.
3. *Peneus tenuis*, Dana, U.S. Expl. Exp., Crust. pt. i. p. 605, pl. xl. fig. 6.—Atlantic coast of Patagonia. Position quite uncertain, except that it does not belong to *Peneus* (s. r.).
4. *Peneus stenodactylus*, Stimpson, Proc. Acad. Nat. Sci. Philad. 1860, p. 43.—Hongkong. Appears to be very closely related to *P. compressipes*, Henderson, the type of the section *Atypopeneus*.
5. *Peneus podophthalmus*, Stimpson, *loc. cit.*—Hongkong. Also seems to resemble *P. compressipes* even more than does *P. stenodactylus*.
6. *Peneus novæ-guineæ*, Haswell, P. L. S. N. S. Wales, 1879, p. 43; and Cat. Austral. Crust. p. 203.—New Guinea. Differs from other *Penei* in not having a hepatic spine.

## IV. DIAGNOSES OF NINE NEW FORMS.

1. *Peneus indicus*, var. *penicillatus*, nov.

*Peneus penicillatus*, Wood-Mason, MS. (name only).

This variety is distinguished by the form of the external maxillipeds of the male. In these appendages the carpus and propodite are much shorter and coarser than they are in *indicus* and *merguiensis*, but, on the other hand, the *dactylus* is a long tapering joint from  $1\frac{1}{2}$  to  $2\frac{3}{4}$  times the length of the propodite, and the pencil of hairs occupying the groove on the inner side of the dactylus is of almost corresponding length.

The rostral crest is not so high as that of *indicus*, var. *merguiensis*, but is higher than that of typical *indicus*, and this intermediate form of rostrum also characterizes females taken in company with males of *penicillatus*, a fact which prevents us, for the present, from regarding *penicillatus* as merely an allomorphic male of *P. indicus*.

This form grows to a length of 6 inches. Numerous specimens have been taken off the Orissa coast and at Bombay, and a few from Karáchi, the Gangetic Delta, and Mergui (Marine Survey collection).

2. *Parapeneus longipes*, sp. n.

Resembles *P. fissurus*, Sp. Bate, from which it is distinguished by the following characters:—

The rostrum in the female barely reaches the end of the first joint of the antennular peduncle. There is no trace of a branchiostegal spine at the antero-inferior angle of the carapace.

The inner (longer) antennular flagellum is about as long as its peduncle in the female, and a little longer in the male.

The external maxillipeds reach the tip of the antennal scale and the last pair of thoracic legs reach a dactylus-length beyond them.

The andrium is formed on the same plan, but in the single male obtained it ends in a pair of (median) ragged petaloid lobes and a pair of (lateral) stiff, curved, horn-like filaments.

The thelycum consists of a broad longitudinally grooved plate occupying all the space between the fifth pair of legs, articulating with a horseshoe-shaped or concave and semi-circular plate lying between the fourth pair of legs.

The female attains a length of  $3\frac{1}{4}$  inches.

Thirty-one females and a male have been collected in the following localities :—Off the Malabar coast (Mangalore) in 21–26 fathoms ; off the Orissa and Ganjam coasts in 20–68 fathoms ; off the Vizagapatam coast in  $7\frac{1}{2}$ –23 fathoms ; and off the south coast of Ceylon in 20 fathoms.

In the single male the rostrum is broken.

This species is distinguished from all those Indian *Parapenei* which have longitudinal and transverse carapacial sutures by the absence of a branchiostegal spine from the antero-inferior angles of the carapace.

### 3. *Metapeneus stridulans* (Wood-Mason, MS.).

*Crotalocaris stridulans*, Wood-Mason, MS. (name only).

Of this species we possess about 130 specimens dredged by the 'Investigator,' and one, identified by Spence Bate as *Peneus velutinus*, Dana, from the 'Challenger' collection.

The species may probably prove to be identical with the *Parapeneus akayebi* of Miss Rathbun.

It is characterized by the presence in both sexes of a pair of stridulating-organs, situated one on each side of the carapace, near the middle of the posterior end of the branchiostegite, in such a way that the anterior edge of the first abdominal tergum can play over them. Each organ consists of a longitudinal row of vertically disposed ridges, which vary in number, being usually five, seldom less than five, and occasionally as many as twelve.

The species is a typical *Metapeneus*, and belongs to the same group as *M. philippinensis* and *coniger*.

Integument remarkably thick, hard, and tomentose.

Rostrum nearly straight, upturned, sometimes reaching to the end of the antennular peduncle, but often shorter, armed dorsally with 5–8 teeth, the last of which is small and isolated (epigastric). No postrostral crest. An indistinct postocular denticle. Postantennular (antennal) spine very strong, produced backwards as a strong convexity defining a broad postantennular sulcus. Hepatic spine small ; cervical groove present only in its neighbourhood. Branchial region not defined except by a short crescentic crease below the hepatic spine. Antero-lateral (antero-inferior) angles of carapace spiniform. A pair of stridulating-organs as already defined.

The second abdominal tergum is medially carinated in less than its posterior half, the third in almost all its extent, the carina in both cases being sulcate ; the fourth to sixth are all sharply carinated, the carina of the fourth and fifth

being deeply cleft at its after end. The sixth abdominal somite is nearly twice as long as the fifth, but shorter than the telson. The telson is about as long as the inner caudal swimmeret; it ends very acutely and has near the apex four pairs of large marginal spines, the last pair being fixed.

Eyes large. Antennular flagella equal, about one third the length of their peduncle.

The third maxillipeds nearly reach the tip of the antennal scale; the dactylus is slender and is not much shorter than the propodite, with which it articulates end on; the basis bears an antrorse spine. A similar spine is present on the basis of the first two chelipeds and on the ischium of the first.

In the female only there is a pair of sternal spines between the second pair of chelipeds.

All the thoracic legs have longish exopodites.

The andricum, which is built in the same way as that of *M. coniger*, is asymmetrical, the left lobe being the longer; the outer lobule of the left lobe ends in a crown of stiffish filaments.

The thelycum consists of the following parts:—(1) between the fifth pair of legs a transverse lamina more or less distinctly divided into three lobes, the outer of which (abutting on the fifth legs) are bluntly dentiform; (2) between the fourth pair of legs a broad transverse plate, the anterior part of which shows as a large, smooth, somewhat oval facet; (3) in the interval between the fourth and fifth legs a narrow transverse bar, sinuous and shaped like a very open **W**.

Large females may attain a length of  $3\frac{3}{4}$  inches.

The species has been taken in abundance all along the east coast of the Peninsula where any rocky patches occur, from Orissa to Palk Strait, in 20–35 fathoms; in the Gulf of Martaban, in 20 fathoms; and at various places in the Andamans, in 20 fathoms.

#### 4. *Parapeneopsis maxillipedo*, sp. n. ?

? an *Peneus cornutus*, Kishinouye, Journ. Fish. Bureau, Tokyo, viii. 1903, i. p. 23.

Compared with *Parapeneopsis stylifera* (Edw.) it presents the following differences:—

The dorsal half of the carapace is tomentose. The rostrum is recurved at tip, but otherwise is nearly horizontal; it does not reach the end of the antennular peduncle in either sex, and it is armed dorsally with 8–10 teeth (not including the isolated epigastric tooth), which form a very decided crest.

The postrostral carina, which is continued right up to the posterior border of the carapace, is sharp and particularly prominent.

The antero-inferior angles of the carapace are merely dentiform; the sinuous subhepatic ridge (defining the anterior part of the cervical groove) stops far short of the antero-inferior angle of the carapace.

The longitudinal fissure of the carapace extends only a short way behind the level of the hepatic spine.

The telson is short and has no marginal spinelets.

The antennular flagella, which are equal, are about two thirds the length of their peduncle.

All the joints of the third maxillipeds except the dactylus are abnormally broad, coarse, and tomentose.

The fifth pair of thoracic legs reach only to the middle of the antennal scale. The basal spines of the chelipeds are big, and in the female there is one on the third chelipeds as well as on the first and second.

The andricum has on its outer edges the same basal wing-like lobule as that of *Parapeneopsis sculptilis*, Heller, but the organ ends in a pair of long calipers.

The thelycum is concave and three-lobed; the middle lobe is very large and leaf-like; the lateral lobes, lying between the fifth pair of legs, are small and have between them in the middle line a globous tubercle, behind which is a thick tuft of long setæ.

This species, which attains a length of  $4\frac{1}{2}$  inches, has been taken at Bombay, at Madras, and off the Arakan coast. It may turn out to be Kisbinouye's *Parapeneopsis cornuta*, a Japanese species which Nobili has also recorded from Bombay.

##### 5. *Parapeneopsis uncta*, sp. n.

Compared with *Parapeneopsis stylifera* (Edw.) this species exhibits the following points of difference:—

The integument is even thicker and denser, and, though sparsely punctate, has a polished greasy appearance.

The rostrum has but a faint double curve, and, owing to the absence of any styliform prolongation, reaches only to the middle of the second joint of the antennular peduncle in both sexes.

The antero-inferior angles of the carapace are sharply rectangular, not spiniform or dentiform.

As in *Parapeneopsis sculptilis*, Heller, the postrostral carina is canaliculate and the sinuous subhepatic ridge

(defining the anterior portion of the cervical groove) does not reach the antero-inferior angle of the carapace.

Dorsal of the hepatic spine the cervical groove is very distinct up to the longitudinal suture of the carapace, this being a quite distinctive feature.

The longitudinal suture of the carapace runs nearly to the level of the transverse suture.

The sixth abdominal somite is as long as the telson; the telson is very short, not reaching the middle of the inner caudal swimmeret, and is without marginal spinelets.

The antennular flagella are equal and a little shorter than their peduncle.

The third maxillipeds nearly reach the middle of the antennal scale and surpass the tips of the fifth thoracic legs.

The spine on the basis of the first chelipeds is very slender and that on the second chelipeds is not distinguishable.

The andricum, like that of *P. sculptilis*, has on each outer margin a wing-like basal lobule, beyond which it simply tapers, to end in four hooks, of which the anterior pair are small and are concealed by the posterior pair in the flexed position of the organ.

The thelycum consists of a square plate between the fifth pair of legs and a semicircular one between the fourth.

Ganjam coast, 10-11 fathoms.

The largest male is  $3\frac{1}{2}$  inches long.

#### 6. *Parapeneopsis nana*, sp. n.

This is a small species, the largest female being only  $2\frac{1}{4}$  inches long, but from the finished form of the andricum (petasma) I take the representatives of it to be adult.

Compared with *Parapeneopsis stylifera* (Edw.) it shows the following differences:—

The rostrum, though in all respects similar, is shorter, so that its styliform portion does not quite reach the end of the antennular peduncle. The postrostral carina fades away at the posterior fourth of the carapace.

The antero-inferior angle of the carapace is sharp-cut, but not spiniform, and the sinuous subhepatic ridge defining the anterior part of the cervical groove falls far short of it.

The telson is generally shorter than the sixth abdominal somite; its median dorsal groove is short and shallow, and it has no lateral marginal spinelets.

The antennular flagella, which are equal, are about one third the length of their peduncle. The fifth pair of legs reach only to the middle of the antennal scale.

The andricum is slender and ends in a pair of long, straight, stiff filaments, which stand out at right angles to the rest of the organ.

The thelycum resembles that of *Parapeneopsis sculptilis*, Heller, its most conspicuous part being a large leaf-shaped median plate lying between the fourth pair of thoracic legs.

Numerous specimens have been taken off the Ganjam and Orissa coasts up to 68 fathoms and at Madras.

#### 7. *Parapeneopsis acclivirostris*, sp. n.

This small species is quite peculiar among *Penei* in having no epipodites on any of the thoracic legs and *no isolated epigastric tooth*.

Compared with *Parapeneopsis stylifera* (Edw.) it also shows the following points of difference:—

The rostrum in the female, though recurved at tip, is nearly straight and uptilted; it may reach or may fall short of the end of the antennular peduncle; it has seven teeth and is not produced as a carina behind the gastric region.

The antero-inferior angle of the carapace is sharp-cut but not spiniform, and the subhepatic ridge, defining the anterior part of the cervical groove, stops far short of it and is elegantly ciliated.

The longitudinal suture of the carapace reaches some way behind the gastric region.

The sixth abdominal somite is as long as the telson, which is short and has no marginal spinelets.

The antennular flagella are equal and are not much more than half the length of their peduncle.

The external maxillipeds and fifth pair of legs reach nearly to the middle of the antennal scale.

The thelycum consists of a concave semicircular plate lying between the fourth pair of legs and a squarish plate occupying the space between the fifth pair of legs.

This species is found in the Persian Gulf, in Palk Strait, at Madras, and off the Vizagapatam and Ganjam coasts.

All the thirty-four specimens taken are females, and the largest is only  $2\frac{1}{2}$  inches long.

#### 8. *Parapeneopsis Hungerfordi*, sp. n.

This species resembles *P. acclivirostris* in having only one epipodite on each side, namely, the one borne by the second maxillipeds.

In other respects it resembles *P. sculptilis*, Heller, except in the following particulars:—

The antero-inferior angles of the carapace are merely rectangular, not dentiform, and the antennular flagella of both sexes are shorter than their peduncle. In these particulars it resembles *P. uncta*.

The andricum ends in a pair of large petaloid lobules, the tips of which are incurved, and its basal lateral lobules have the free edge deeply notched.

The thelycum is a narrow longitudinal plate, laterally constricted or notched near the middle and almost cut in two by a deep longitudinal furrow; it ends posteriorly in a pair of knob-like facets.

A male and two females from Hongkong, presented by Surgeon-General R. Hungerford.

In the females the rostrum is like that of many specimens of *P. sculptilis*, but in the male it is short, barely reaching the end of the second joint of the antennular peduncle, and nearly straight; it is dangerous, however, to settle the specific form of such a variable structure as the rostrum from an examination of three specimens.

#### 9. *Trachypeneus asper*, sp. n.

Integument very thick and hard, tomentose, finely scabrous.

Rostrum quite straight, uptilted, strongly so in the female, not reaching the end of the second joint of the antennular peduncle; dorsally it is armed with nine or ten teeth (not including the isolated epigastric tooth), which form a crest. Postrostral carina low, broad, and faint, nearly reaching the posterior border of the carapace. An orbital spine. A strong postantennular (antennal) spine, the buttress of which reaches the hepatic fossa. A fine suture runs along the anterior part of the floor of the shallow postantennular sulcus. A similar transverse suture is seen on the branchiostegite at the level of the third pair of chelipeds. Hepatic spine rather small. Antero-inferior angles of carapace distinctly dentiform. A very indistinct subhepatic groove (the anterior part of the cervical groove) runs from the base of the postantennular buttress to the base of the hepatic spine; dorsal of the hepatic spine the groove cannot be distinguished.

On the second abdominal tergum there is a median compressed tubercle. The third to sixth terga are very



sharply carinated. The fifth abdominal somite is about two thirds the length of the sixth, the sixth is about as long as the telson. The telson, which is dorsally grooved, is much shorter than the inner caudal swimmeret, ends rather abruptly, and has on either side a very obscure subterminal marginal spinlet.

The antennular flagella of the male are about three fourths, those of the female about two thirds the length of their peduncle; the lower flagellum is much the coarser. The third maxillipeds are coarse, except the dactylus, and reach into the anterior third of the antennal scale. The last pair of thoracic legs reach at least a dactylus-length beyond the tip of the antennal scale. A basal spine is present on the first two pairs of chelipeds. All the thoracic legs have petaloid exopodites.

The andricum is anchor-shaped.

The thelycum consists of a transverse bar between the fifth pair of legs and a concave semicircular plate between the fourth.

The female reaches a length of  $3\frac{3}{4}$  inches. The colours in life are pink, the abdominal carinæ and thoracic appendages being milk-white.

The species has been taken in the Persian Gulf, off the Vizagapatam and Ganjam coasts in depths of 20-35 fathoms, and off the Andamans in 60 fathoms.

It differs from *T. curvirostris*, Stimpson (= *T. anchoralis*, Spence Bate), of which we have both 'Challenger' specimens from Japan and other specimens from Hongkong, in the following particulars:—

The rostrum is quite straight and has more teeth, and the postrostral carina is much fainter.

The antero-inferior angles of the carapace are sharper and the anterior part of the cervical groove is much less distinct.

The antennules are shorter both in their peduncle and in their flagella, and the fifth pair of legs are longer.

Though the andricum is similar, the thelycum is a good deal different, specimens of the same size being compared.